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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/854,083	05/11/2001	Zhengquan Tan	A5771/T42200	6984

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APPLIED MATERIALS, INC.
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EXAMINER

COLEMAN, WILLIAM D

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 10/22/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/854,083

Applicant(s)

TAN ET AL.

Examiner

W. David Coleman

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 July 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-41 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) Z.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed July 17, 2002 have been fully considered but they are not persuasive.

Applicants contend that the 35 U.S.C. § 102(e) rejection of Lee et al., U.S. Patent 6,258,407 B1, herein known as Lee does not anticipate the claim because the arrangement of the claimed elements is different from the arrangement of the prior art elements. In particular, Lee does not deposit a silicon oxide film as recited in claims 1-4.

In response to Applicants contention that Lee fails to deposit a silicon oxide film, Applicants are directed to Example 1 (column 13, lines 15-68 and column 14, lines 1-12). Lee teaches the process as claimed by Applicants where a modified silicon oxide film is deposited using a high density plasma deposition process.

Applicants contend that Lee deposits an amorphous carbon and fluorinated amorphous carbon films.

In response to Applicants contention that Lee deposits an amorphous carbon and fluorinated amorphous carbon film, please see column 11, line 59 where Lee distinctly teaches forming a modified SiO₂.

Applicants contend that the rejection under 35 U.S.C. § 103 (a) of claims 5-9 is improper because Lee does not anticipate claim 1 nor discloses a high density plasma.

In response to Applicants contention of the 35 U.S.C. § 103 (a) rejection of claims 5-9 as being improper, Applicants are referred back to the arguments cited in the above discussion and therefore moot.

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Applicants contends that Lee fails to teach a high density plasma process and therefore does not teach Applicants invention.

In response to Applicants contention that Lee does not teach a high density plasma process, Applicants arguments are moot. Lee teaches various processes including a high density plasma process (see Abstract).

Applicants contend that the rejection of claims 10-24 is improper because Applicants admitted prior art does not teach heating the substrate to a temperature at or above 450⁰C during deposition of the high density plasma oxide and that Lee teaches a different process.

In response to applicant's argument that Lee teaches a different process, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Applicants also contend that Applicants admitted prior art does not teach all the limitations, specifically claim 10 recites forming a plasma from a first gas and thereafter forming a plasma from a process gas.

In response to Applicants contention that Applicants admitted prior art fails to teach a first gas being different from a process gas, Applicants are directed to there own disclosure on page 2, where Applicants teach an inert gas as argon for the HDP-CVD process for forming silicon oxide film. Therefore Applicants arguments are moot.

Applicants contend that the rejection to claim 6 is improper because it ignores the true teachings of Applicants admitted prior art and teaches away from Applicants invention.

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In response to applicant's argument that the admitted prior art teaches away for Applicants invention, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Applicants contend that claims 15 and 17 are allowable because such films are likely to be subject to relatively high temperatures during later processing.

Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 2, 3, 4 and 25 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al., U.S. Patent 6,258,407 B1.

3. Pertaining to claims 1 and 2, Lee discloses a semiconductor process as claimed. See **FIGS. 1-6**, where Lee discloses a method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

flowing a process gas into the substrate processing chamber **120**, said

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process gas comprising a silicon-containing source SiH₄ (column 1, line 63), an oxygen-containing source H₂O₂ (column 1, line 63) and a fluorine-containing source C₂F₆ (column 2, line 32);

forming a plasma from said process gas; and

heating the substrate **140** to a temperature above 450⁰C during deposition of said silicon oxide **620**.

4. Pertaining to claim 3, Lee discloses wherein the substrate is maintained at a temperature of 500⁰C (column 11, line 67).

5. Pertaining to claim 4, Lee teaches wherein said silicon-containing gas is SiH₄.

6. Pertaining to claim 25, Lee teaches wherein the silicon oxide layer is used as a premetal dielectric layer (intermetal dielectric, column 4, line 49) or part of a shallow trench isolation structure.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 5, 6, 7, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al., U.S. Patent 6,258,407 as applied to claims 1, 2 3 and 4 above, and further in view of Applicants prior art.

9. Pertaining to claim 5, Lee fails to disclose wherein the oxygen-containing source is O₂.

Applicants admitted prior art teaches wherein the oxygen-containing source is O₂. See page 2 of

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disclosure wherein O₂ is taught as an oxygen-containing source. In view of Applicants admitted prior art, it would have been obvious to one of ordinary skill in the art to incorporate O₂ into the Lee process because the motivation is that O₂ can be readily substituted for oxidation material of Lee to form a dielectric material.

10. Pertaining to claim 6, Lee fails to disclose wherein said silicon oxide layer has a fluorine content of less than 1.0 at. %. Applicants admitted prior art teaches wherein many semiconductor manufactures require that PMD or STI have less than 1.0 at. % fluorine (page 3, lines 20-21). In view of Applicants admitted prior art, it would have been obvious to one of ordinary skill in the art to have a fluorine content of less than 1.0 at. % because fluorine is more likely to outgas and migrate into an adjacent layer (page 3, lines 17-19).

11. Pertaining to claim 7, Lee teaches wherein said fluorine-containing source is either NF₃ or a fluorocarbon having a formula of C_nF_{2n+2} where n is a positive integer (column 2, line 32).

12. Pertaining to claim 8, Lee teaches wherein the plasma has an ion density of at least 1X10¹¹ ions/cm³ (column 13, line 11).

13. Pertaining to claim 9, Lee fails to teach the flow ratio of said oxygen-containing source to said silicon-containing source is between 1.4-3.0:1. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the

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chosen dimensions are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

14. Claims 10-24 and 29-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants admitted prior art in view of Lee et al., U.S. Patent 6,258,407 B1.

15. Pertaining to claims 10, 17, 28 and 29, Applicants admitted prior art discloses a semiconductor process substantially as claimed. See pages 2-3 of Applicants disclosure where Applicants teach a method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

(a) flowing a first gas (Ar and O₂) into the substrate processing chamber;

(c) flowing a process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine containing source into said substrate processing chamber. However, Applicants admitted prior art fails to teach: (b) forming a plasma having an ion density of at least 1×10^{11} ion/cm³ from said first gas and (d) forming a plasma having an ion density of at least 1×10^{11} ions/cm³ from said process gas and allowing said plasma to heat said substrate to a temperature at or above 450°C during deposition of said silicon oxide layer. Lee teaches forming

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a plasma having an ion density of at least 1×10^{11} ions/cm³ to heat said substrate to a temperature at or above 450°C. See columns 11 and 12, where Lee teaches the wafer is heated to 500°C and the plasma has an electron density of about 10^{12} ions/cm³. In view of Lee, it would have been obvious to one of ordinary skill in the art to incorporate the heating temperature of the wafer and the ion density of the plasma in the Admitted prior art of Applicants because the Examiner believes that they are the fundamental principles of plasma physics of ionized gases.

Pertaining to claims 27, Lee teaches wherein the silicon oxide layer is used as a premetal dielectric layer.

Pertaining to claims 29 and 30, Applicants admitted prior art teaches a gapfill process.

Pertaining to claim 31, Applicants admitted prior art discloses a fluorine content of less than 1%. It appears that 0.6% is less than 1%.

Pertaining to claims 32 and 33, Applicants admitted prior art teaches SiH₄, which is a silicon containing gas and O₂, which is a oxygen containing gas.

16. Pertaining to claims 11, 12, 15 and 15, Applicants admitted prior art teaches an oxygen-containing source O₂, a silicon-containing source SiH₄ and a fluorine content of less than 1.0 at. %.

Pertaining to claims 13, 16, 20 and 21, Applicants admitted prior art fails to teach wherein said fluorine-containing source is either NF₃ or a gas having the formula of C_nF_{2n+2} where n is a positive integer and the plasma heats said substrate to a temperature of 500°C or more. Lee teaches wherein the fluorine-containing source is either NF₃ or a gas having the formula of C_nF_{2n+2} where n is a positive integer and the plasma heats said substrate to a temperature of 500°C or more. In view of Lee, it would have been obvious to one of ordinary skill in the art to

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incorporate the fluorine-containing source of Lee and the plasma heating of said substrate to a temperature of 500⁰C or more in Applicants admitted prior art because the Examiner believes the motivation is to fabricate stable dielectric films.

17. Pertaining to claims 14, 18, 19, 22, 23 and 24, Applicants admitted prior art fails to teach wherein the fluorine content is less than 1.0 at. %, and fails to teach flow ratios of the process gases. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

Claims 34, 35, 36, 37, 38, 39, 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants admitted prior art in view of Lee et al., U.S. Patent 6,258,407 B1 as

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applied to claims 10-24 and 28-31 above, and further in view of Nag et al., U.S. Patent 6,268,297 B1.

The combined teachings of Applicants admitted prior art in view of Lee discloses a semiconductor process substantially as claimed. However, the combined teachings fail to teach wherein the silicon oxide layer is doped with a phosphorous source containing PH₃. Nag teaches a high density plasma oxide wherein the oxide is doped with a phosphorous source containing PH₃. See column 3, lines 46-68, where Nag teaches doping an oxide with a PH₃ source. In view of Nag, it would have been obvious to one of ordinary skill in the art to incorporate the phosphorus source, PH₃ of Nag into the combined teachings of Applicants admitted prior art and Lee because phosphorous-doped film serves as a barrier to mobile-ions that may be in the vicinity of transistors (column 3, lines 51-54).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

The additional new claims of 34-41 required a new search for the limitation of a phosphorous containing source.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 703-305-0004. The examiner can normally be reached on 9:00 AM-5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7721 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

W. David Coleman
Examiner
Art Unit 2823

WDC
October 12, 2002

A handwritten signature in black ink, appearing to read 'W. David Coleman', with a horizontal line drawn underneath the signature.